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NASA Advisory Council Study of Effective Shuttle Utilization

NASA ADVISORY COUNCIL
STUDY OF EFFECTIVE SHUTTLE UTILIZATION

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***Conducted by
The NAC Task Force
for the Study of
Effective Shuttle Utilization***

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EXECUTIVE SUMMARY

A. INTRODUCTION

In January 1983 the NASA Advisory Council, at the request of James Beggs, NASA Administrator, commissioned the Task Force on Effective Shuttle Utilization to help determine how the United States can develop and market the use of the Shuttle space transportation system (STS) in the face of expendable launch vehicle (ELV) competition, both foreign and domestic. A broadly based senior level committee was recruited encompassing the disciplines of engineering, operations, management, and finance.

The approach taken was to pose four key questions for the working groups as follows:

- o How can the Shuttle operations be improved to enhance customer appeal?
- o What opportunities exist to increase the utilization of the Shuttle?
- o Are there any needed changes in NASA's policies governing use of the Shuttle?
- o How can NASA improve its marketing of the Shuttle capabilities?

The Task Force organized itself into four working groups, one for each question, with the members as follows:

- o Shuttle Operations

Earl Hilburn, President, Western Union (Ret.)
Robert Roney, Vice President, Space and Communications,
Hughes Aircraft

- o Shuttle Utilization

Abe Silverstein, Director, Lewis Research Center (Ret.)
Lt. Gen. Thomas Morgan, USAF (Ret.)
James Waugh, Executive VP, Pan American (Ret.)
Col. Charles Gandy, Jr., USAF (Ret.)

- o NASA Space Transportation Policies

John Yardley, President, McDonnell Douglas Astronautics
James Martin, VP and General Mgr., Martin-Marietta (Ret.)

- o Shuttle Marketing

James McDivitt, VP, Strategic Management, Rockwell
Fred Bradley, Senior Vice President, Citibank

Over a period of six months, the committee met four times as a full group. Interspaced between these meetings were numerous fact-finding field trips by the four working groups into which the task force was subdivided. Each working group then reported its findings, conclusions, and recommendations, which were reviewed by the entire Task Force at the last of its four meetings and integrated as a comprehensive report. A summary of the results is presented in the four following sections of this Executive Summary. The four individual papers of the working groups, providing more detail on the groups' deliberations and the results, follow.

B. SHUTTLE OPERATIONS

The study of Shuttle operations from the customers' point of view concentrated on communications satellite operators, because they dominate the commercial user community and are expected to continue to do so for some time. The conclusions and recommendations, however, are felt to apply generally to much of the rest of the user community. Meetings were held with eight commercial communications satellite users, six domestic and two foreign. These interviews established that the overwhelming appeal of the Shuttle as a launch vehicle to these users lies in its relative launch price advantage, resulting from a pricing policy established to attract customers. There is concern that this policy pricing may not continue, but while it does, the users are willing to accept certain inconveniences related to riding the Shuttle as opposed to an ELV. These inconveniences, e.g., schedule slips, integration complexities, are perceived as reflecting NASA's preoccupation in developing the Shuttle per se as opposed to improving customer services.

Paramount among user concerns are, of course, schedule reliability and potential added cost and lost revenue. The STS is for all practical purposes still in the development stage. A considerable number of additional flights will probably be required to wring out all the technical and operational bugs. Further, a fully operational maintenance and spares program has yet to be implemented. The commercial users feel that NASA should provide an ELV back-up capability for those users who can use it by virtue of their designs. We believe that the most practical way to provide this schedule protection is by continuation of ELV backup until the STS schedule reliability is well established, and that in the meantime the Shuttle manifest could be thinned by a scheduled off-load of some fraction of the ELV-compatible payloads. In addition to providing a surge and back up capability to assure schedule reliability, this would assure that the nation does not shut down all active production lines for launch vehicles and would maintain the ability to economically launch small satellites from Vandenberg.

The study identified a great need to simplify the overall process of payload-Shuttle planning, documenting, and processing. The interface requirements and the amount of documentation required by NASA for the Shuttle vastly exceed those which users are accustomed to with ELVs. The interface requirements are distributed through numerous annexes to the Payload Integration Plan. Furthermore, the customer is required to interface with a multitude of specialist groups in NASA Headquarters, the NASA centers, the Cape Canaveral Air Force Station, and their contractors. This entire process is in need of considerable streamlining.

Lastly, it was felt by the customers that the Shuttle payload processing facilities are in need of upgrading, and that their present condition reflects the lack of customer service orientation within NASA.

The study of Shuttle operations yielded the following key recommendations:

- o Continue ELV operations until STS schedule reliability is well established and accepted by the customers.
- o Provide for turnover of the ELV inventory by offloading some fraction of ELV compatible payloads from Shuttle to ELVs.
- o Adjust the contractual penalty schedule to achieve equity between payload-caused delays and Shuttle-caused delays.
- o Improve flexible manifesting at a late date to permit substitution of available payloads on relatively short notice.
- o Implement an improved maintenance and spares program.
- o Establish a single point program management authority to manage all Launch Services Agreement interfaces, including all Payload Integration Plan annexes.
- o Establish standard interfaces for common payload classes, minimizing or eliminating the software interface with Shuttle.
- o Critically evaluate the payload processing facilities required at the Kennedy Space Center, and, as necessary, enlarge and upgrade them to support the projected payload traffic, or facilitate implementation of contractor-furnished facilities.

C. SHUTTLE UTILIZATION

This portion of the study dealt with identifying potential new customers and payloads for the Shuttle. It concentrated on government laboratories, both NASA and Department of Defense, but also gave some consideration to potential commercial customers other than communications satellite operators, in part through examination of existing studies.

The subgroup visited NASA's Langley, Ames, and Lewis Research Centers, as well as the Goddard Space Flight Center. They found some discouragement with the level of support for new ideas to be tested in space flight. Inadequate funding, complex procedures, low priority, and schedule uncertainty with regard to research flights on Shuttle were all cited as problems. This situation needs attention, because these centers are, for NASA, the intellectual gardens in which the seeds of the future grow; a Shuttle-flown research activity can be expected to provide major advances, and perhaps much future Shuttle business, even though not a major Shuttle user now.

The subgroup visited the Air Force's new Space Technology Center, where they heard presentations from a number of Air Force laboratories and the Naval Research Laboratory. The situation in the military laboratories was similar but seemed slightly better. Funding is already substantial, with the promise of further increase as development of defensive weapons in space moves forward. In fact, if this materializes, it is well to realize that the Space Shuttle will in all likelihood become an essential rather than an alternative launch vehicle, supporting the view that the Shuttle should not be overburdened with commercialization objectives.

With regard to potential commercial users at home and abroad, the Task Force found only a limited near-term potential for this class of users. However, approximately twenty companies are now participating with NASA in promising research to identify new applications for potential Shuttle flight, and NASA must continue to cultivate this field in the expectation that, with the passage of time, additional candidates for commercial in-space ventures will emerge.

The following recommendations are offered:

- o Because of the merits of the research, a concerted effort should be made to increase the funding level for space-related R&D at government laboratories where there exists a small, well-defined workload in science, technology, and applications.

- o Action should be taken to streamline and simplify the process of getting this class of payload on Shuttle flights.
- o NASA, in concert with the DOD, should posture the Shuttle program to support actively the expanding defense space R&D program. We believe that the Shuttle should be deemed essential for national defense, with less importance attached to economics.
- o NASA should review its organizational structure and resource allocation in support of industrial R&D to assure that this small but important activity is properly nurtured.

D. NASA SPACE TRANSPORTATION POLICIES

The Task Force reviewed all available current policy statements, as well as many draft policies, and found them generally appropriate. The areas that came in for most discussion were policies on pricing, standby and postponement, back-up launch vehicle, and STS and ELV commercialization, as well as the need for a stable national space policy.

The Task Force felt that NASA's Shuttle pricing policies designed to encourage new space users are very good. A number of additional inducements to potential space entrepreneurs, such as special discounts and longer term price commitments, were also discussed and NASA is encouraged to continue to look at other incentives.

NASA's standby and postponement policies leave much to be desired from the users' standpoint. The Task Force believes that NASA should examine them closely and ease them. Some suggestions for reduced penalties are included in the body of this report.

The NASA policy to phase out all expendable launch vehicles in the very near future came up for substantial debate. The judgment of the Task Force is that NASA is doing this prematurely; it is convinced that the Delta launch vehicle should be retained for some time into the future as a NASA launch vehicle complementary to the Shuttle. With a pricing policy that charged a common price for either Delta or Shuttle flight, and with spacecraft compatible with either launcher, considerable flexibility would result, a "surge" capability for heavy demand periods would be available, and adequate backup would be provided.

The potential for the successful privatization of ELVs was considered fairly low by the Task Force. It seems probable that following divestiture by NASA of an ELV to an entrepreneurial company, that company would exert every effort to cause the

Shuttle pricing to be revised upwards in order to make the ELV more competitive. This would run counter to the Shuttle pricing policy and its objectives.

The Task Force felt that heavy NASA and DOD use of the STS would tend to make STS privatization impractical, and that any move to shift operations to some other government organization would be premature.

There remains an overriding national need for a stable space policy that can survive various administrations and give long range direction and purpose to the United States space program, covering those elements of the program pertinent to space investors and users. Such stability is an important aspect of inducing potential private investors in space to accept the large risks inherent in such ventures.

The following policy-oriented recommendations are made:

- o NASA should offer price and service inducements to stimulate private investment in space R&D and new uses for space transportation.
- o NASA should review the postponement policies with a view toward reducing the penalties, and treat any resulting funding shortfall in the same manner as the reflight guarantee.
- o NASA should review the discount policy for standby payloads to determine whether there would be takers if the discount were raised, and whether this would be in the best interests of the overall system.
- o The Delta ELV should be retained for some time into the future as a NASA launch vehicle complementary to the Shuttle (4 launches per year with 6 backups). The need for other ELVs should continue to be studied.
- o A common price should be charged for either a Shuttle flight or a Delta flight, even if a modest increase to the current price is required.
- o NASA should give some attention to the formulation of a policy that would give guarantees to space investors of stable service for 15 or more years.
- o NASA should go slow on STS privatization.
- o A "one-stop-shopping" policy to assist users in dealing with NASA should be adopted--including financing, insurance, etc.

E. SHUTTLE MARKETING

There was general agreement in the Task Force that an intensive high level marketing effort on behalf of Shuttle utilization is warranted. In this context, marketing means to develop and implement a broad scale and long range plan to involve increasing numbers of users in the exploration of the STS capabilities. It thus involves market analysis, planning, advertising, customer service, financing, and insurance, to name a few areas. It must be a high level, strongly led effort, with the active participation of NASA top management to the Administrator level.

During the course of this study, NASA acted to further strengthen its Shuttle marketing effort. The Task Force was favorably impressed with the results to date. Some additional organizational changes would appear to be in order to strengthen the effort. The Task Force feels that the central marketing function should exist within NASA, but that the services of a support contractor would greatly enhance the effort by bringing in skills best obtainable from a broadly based firm.

One of the primary drivers for the marketing effort is the emergence of increased competition. Commercial customers are faced with the phase out of some launch vehicles, the introduction of Ariane, and the possible entry of the USSR and Japan in the launch business, in addition to the opportunities on the Shuttle. While the U.S. should not expect to hold a monopoly on commercial space launches, and as a matter of fact has never enjoyed such, it is reasonable to compete strongly for this market. Extensive analysis of customer requirements will be an important element of the effort to capture a good share of the market.

The potential low cost of launches will continue to be the most attractive feature to the Shuttle user for some time to come. Continued policy pricing for commercial users seems justified in view of their "add-on" nature to missions that would be flown anyway for governmental purposes. Other attractions of Shuttle launch, such as manned involvement, recovery and repair in orbit, etc., remain to be fully developed, but can become important to users if designed to their needs.

The Task Force looked into the questions of financing and insurance of payloads. Domestic practices were compared with those of foreign countries. While disparities in practice have not played a large role to date, this is an area well worth watching as the competition to launch commercial payloads continues to heat up.

The following marketing recommendations are made:

- o NASA should strengthen its central marketing organization to deal with the Shuttle customer and Shuttle operations. This should include undertaking a number of marketing-related actions, and establishing policies to provide the necessary marketing tools.
- o A position of Deputy Associate Administrator of Space Flight, Shuttle Customer Services, or its equivalent, should be established.
- o NASA should select a single private company to assist in the marketing of the Shuttle and to provide contract support to NASA and its customers in the entire interface area.
- o NASA should establish a detailed marketing plan with top management review and approval.
- o Arianespace financing should continue to be closely tracked to preclude any unfair advantage, which, in turn, might require ExIm Bank response.
- o NASA should consider writing, for a fee, some of its own insurance.
- o NASA should continue work with the Office of the Special Trade Representative, the Department of Commerce, and the State Department to develop an offset program including a wide variety of goods and services.
- o NASA should install a senior customer finance man in the customer support group.

SHUTTLE OPERATIONS

A. INTRODUCTION

Commercial usage of the STS is currently dominated by the communications satellite operators. For this purpose the Shuttle amounts to simply an alternative means for transport to low earth orbit and release for transfer to geosynchronous orbit. While there are a few other commercial applications scheduled or contemplated, including some attached payload missions, communications satellites will continue to dominate the commercial usage for the foreseeable future. Therefore the analysis made here has been restricted to that market only. The observations and conclusions reached probably apply in some measure to other uses as well, but no user input has been gathered to support such conclusions.

Our approach to this analysis was first to identify the potential features of the STS most appealing and those least appealing to commercial operators, second to study the fundamental bases to the objectionable features, and finally to recommend approaches to alleviation of problems revealed.

To determine the appeal of STS to commercial users, eight commercial communications satellite users (six U.S. domestic users, two foreign users) were queried as to their experience in dealing with NASA for STS use. Three questions were posed:

- o What is there about Shuttle operations that might make one prefer to use an expendable launcher?
- o What extraordinary or unnecessary problem does the STS operations plan give?
- o What suggestions would you recommend to substantially improve the appeal?

B. SUMMARY OF RESPONSES

We can make the following summary observations based on the responses to these inquiries:

The overwhelming positive appeal of the Shuttle lies in current NASA pricing policy, designed to make the Shuttle competitive to currently available expendable boosters. Commercial success of STS hinges on continuation of this margin. Thus any perception of artificiality in this pricing generates concern regarding price stability.

On the other hand, the problems experienced to date in holding to STS launch schedules and the general newness of the payload-Shuttle integration and operations represent a "negative

appeal," as compared to the schedule reliability, convenience and familiarity of a dedicated expendable launcher. We detected no perception among communications operators of any operational advantage from the special characteristics of the Shuttle except for those payloads which, quite frankly, have been designed specifically to take advantage of the Shuttle's pricing algorithm. Rather they perceive too much fascination by NASA with the role of the astronaut, with in-orbit checkout, and with recovery, and not enough emphasis on simply transporting payloads to orbit on schedule at the lowest cost and maximum dependability.

To understand this outlook it is necessary to focus on what the commercial customer seeks. The communications operator is in the business of selling signal transmission from point A to point B. Space systems are of interest to him only as an economical means to accomplish that purpose, and the satellite itself is of interest only in terms of how well it performs that mission, i.e., its transmission parameters, its reliability, and its cost. The means of placing the satellite in orbit is of even less interest. The operator must look upon it in the same manner that he would look upon any other shipping problem, namely dependability and cost.

This gives rise, of course, to the question of how much price differential will be required to retain Shuttle customers in view of this perception of operations disadvantage.

We believe that the major fundamental negative appeal issue is that of schedule confidence, and the likelihood of major user disruption due to either Shuttle or payload coordination problems. We also believe that the single most effective means to relieve this anxiety is to reduce the absolute dependence on the Shuttle schedule through ELV backup, with a consequent thinning of the manifest. Since this impacts directly on the fundamental bases of pricing, we requested a critical examination of the underlying costs of mixed fleet operations, which is being conducted by NASA.

C. DISCUSSION

The principal keys to the commercial appeal of the STS are: (1) maintaining a stable, predictable, price advantage; (2) providing a high confidence in launch scheduling; and (3) simplifying the overall process of planning, documenting, and payload processing.

1. Price Stability

Aside from an overriding concern for the continuation of the present guaranteed price formula, customers generally object to the dependence on inflation indices and the handling of so-called

"optional" services. Users state that it is impossible to gauge the true cost of launching on STS due to the set-up on optional services, etc. The user doesn't feel he can bound his cost when he signs on.

Price should be fixed at time the Launch Services Agreement is established without further inflation indexing. The "optional services" prices should be eliminated except for those services which are truly optional to the customer. A fixed lump-sum charge for each class of standard payload would be substituted.

2. Improved Schedule Confidence

Probably the most severe and most widely perceived impediment to users of STS is the uncertainty with respect to launch schedule. This problem ranges from the uncertainty of long-range manifesting to last-minute delays on the launch pad. Uncertainty of Shuttle manifests causes not only scheduling problems within user organizations but also impacts arrangements for transfer orbit support and insurance coverage. Many commercial users are significantly impacted by schedule delays, with as much as \$1 to \$5 million per month increased investment costs and revenue loss.

Recognizing the complexity of the STS and of its multiple payloads, and the serial nature of the launch capability now existing at KSC, the risk is high that excessive delays will occur. Shuttle-related delays should be relieved eventually with completion of the second pad at KSC, with additional Orbiters joining the fleet, and with increasing maturity of operations. In addition, an improved maintenance and spares program will reduce the risk of delays from equipment sources. Until these have been demonstrated, the NASA projected manifesting will continue to be reviewed by customers as unrealistic and undependable.

A potentially more significant prospect is that of the failure of an individual payload to obtain a launch. With as many as four spacecraft and four perigee stages on a single STS, there is substantial likelihood of at least one failing to come to its final acceptable launch condition in a timely manner. Unfortunately, the determination of launch unacceptability may come very late in a program, entailing substantial schedule extension to remedy an identified problem. The potential contractual consequences of a missed flight are severe in the extreme.

The potential of being "left at the gate" during launch constitutes a very severe problem for both the customer and NASA. The customers are no more interested in an extensive delay to accommodate another user's problem than they are in missing the launch themselves. The provisions of the launch services

contract are thus appropriately severe, but they are regarded as very unsymmetrical when comparing penalties for customer delay versus those for Shuttle delays.

To ameliorate the impact of such loss of slot, provisions need to be made for flexible manifesting at a late date, permitting substitution of an available payload for one dropping out, and remanifesting of the delayed payload. A set of standard interfaces could allow bypassing extensive documentation, integration review, etc.

The current NASA Shuttle manifest projects flights on two-week centers by 1987. With the potential for both Shuttle delay and missed flights by payloads, there is a serious prospect of a traffic jam in launches if the STS is manifested too optimistically. Since a serious backup of launches could have dire consequences for commercial operators, some means for schedule protection is essential. We believe the most practical way to provide this protection is by continuation of ELV backup until the STS schedule reliability is well established, and that, in the meantime, the Shuttle manifest could be thinned by a scheduled off-load of some fraction of the ELV-compatible payloads.

3. Process Simplification

While price and schedule confidence are the most critical determinants for customer decisions on transportation selection, the most widespread reactions to our customer inquiry related to the complexity and the process time for manifest reservation, for payload/Shuttle integration, and for launch preparation.

Users find the long lead-time requirements for manifest reservations and interface documentation both burdensome and incompatible with the reasonable business planning cycles. Aside from the inconvenience caused for customers, reservations made before establishment of firm business plans have the potential of inducing considerable fluidity in Shuttle manifesting.

The interface requirements and the amount of documentation required by NASA for Shuttle vastly exceed those to which users are accustomed with ELVs. Customers feel intimidated by the vast array of NASA documents regarding safety, interpretations of safety, implementation of plans, interface requirements, etc. In addition, conforming to these requirements entails substantial customer cost, which subtracts from the ostensible price advantage of the STS launch service.

The interface requirements are distributed through numerous annexes to the Payload Integration Plan (PIP), which do not necessarily conform to a common format, terminology, or requirements. Furthermore the customer is required to interface

with a multitude of specialist groups in NASA Headquarters, the Johnson and Kennedy Space Centers (JSC and KSC), the Cape Canaveral Air Force Station, and their contractors. From the point of view of NASA's customers, it would be very desirable to consolidate all external Shuttle payload requirements into a single document like the Ariane Users Manual or the Delta Design Restraints Manual. But in any event it is considered necessary that NASA designate a single-point interface for all phases of the launch cycle. The Launch Services Contract is of sufficient cost and complexity to justify a NASA project officer who would be the single-point of contact for all technical and contractual matters between NASA and the user. We believe that NASA would not consider contracting on such a scale with a supplier who provided no such project manager with suitable authority over the relevant resources. The reciprocal need seems obvious.

A similar need is seen at KSC for a stronger coordinated local authority over the array of teams involved in STS payload operations and integration tests. These operations take considerably longer than for a Delta mission, with corresponding larger manpower demands and associated cost. This excess time at KSC, much of it without user access to the payload, also introduces increased risk of inadvertent damage to the payload.

Some of this extended time is inherent in a multi-payload carrier, as it results from necessary queuing of payloads through the integration process. However, with the projected launch rate of payloads by 1985, a queuing bottleneck is foreseen because of the shortage of existing payload processing facilities at KSC. Even currently available facilities are in serious need of upgrade in cleanliness, climate control, and access control. While this problem of queuing can be relieved to some extent by working multiple shifts, the need for some capital facilities expansion and improvement for payload processing seems inescapable.

There remains excessive operations time which can only be solved by simplification of the payload/Shuttle interface complexity. It appears that much of this complexity lies in the software interface with the Shuttle computer system. This interface also accounts for much of the manifest lead time. We see no reason why this complex interface is needed for a simple detachable communications satellite, any more so than with an ELV. There appears to be much to be gained by establishing standard interface requirements for such classes of payloads, permitting bypassing of major segments of the integrated test sequences. We understand that NASA is studying such measures, and we strongly encourage that effort.

D. RECOMMENDATIONS

It is clear that successful commercial utilization of the Shuttle will hinge on maintenance of competitive prices with ELV alternatives. If the fundamental costs support that price advantage, then the ultimate outcome should be assured. However, to transition to that ultimate position and to minimize the required competitive margin, NASA must reduce the operating disadvantages, or the perception thereof. Toward this end we make the following summary recommendations:

To provide necessary insurance for commercial customers against delays that could economically impact them, NASA should:

- o Continue ELV operations until STS schedule reliability is well established and accepted by the customers.
- o Provide for turnover of that ELV inventory by off loading some fraction of ELV-compatible payloads from Shuttle to ELVs.
- o Adjust the contractual penalty schedule to achieve equity between payload-caused delays and Shuttle-caused delays.
- o Improve flexible manifesting at a late date to permit substitution of available payloads on relatively short notice.
- o Implement an improved maintenance and spares program.

To improve Shuttle operations to ease the cost and schedule burden on payload customers, NASA should:

- o Establish a single-point program management authority to manage all Launch Services Agreement interfaces, including all PIP annexes.
- o Establish standard interfaces for common payload classes, minimizing or eliminating the software interface with Shuttle.
- o Critically evaluate the payload processing facilities required at KSC, and, as necessary, enlarge and upgrade them to support the projected payload traffic, or facilitate implementation of contractor-furnished facilities.

SHUTTLE UTILIZATION

A. INTRODUCTION

This section of the report deals with the question "Can Shuttle Utilization Be Increased?" The Task Force chose to review the subject in three parts. Part one focused on the NASA research market and included fact finding at NASA Headquarters and as many NASA laboratories as possible that might have an interest in using the Shuttle as part of their development process. In part two, we looked at some of the Department of Defense laboratories to see how they were planning to use the Shuttle. Part three of this review examined civilian and foreign space research and development activities and plans to see if this afforded a significant potential payload.

B. NASA UTILIZATION

For NASA, we visited the Goddard Space Flight Center, and the Ames, Langley, and Lewis Research Centers. Some observations resulting from these visits are:

1. The Shuttle does offer a new and unique test bed for research and increased support for this area is warranted by the merits of the research. While it is doubtful that the development of the NASA research market could increase the flight rate and contribute to reducing the cost per launch, this market could significantly increase the load factors on flights. For this to happen, an increased priority for this research is required.

The NASA culture has historically emphasized "big science" projects that also provide high media visibility. Smaller experiments that are fundamental to future progress face difficulties in competing successfully for funds and flight opportunities. This has discouraged the experimenters within NASA and the universities and, until the priority of such projects for Shuttle flight is accepted, this research market will not grow significantly. Further, NASA appears to need an advocate-integration office for small experiments in its space science and technology offices similar to that operated by DOD quite effectively.

2. The key to the effective use of the Shuttle for research is low cost experiments that can be reflown in a timely manner. Currently experiments are hampered by a "success the first time" syndrome. "Failures" are penalized through the visibility given them by the use of high level investigating teams and publicity. Often in research as much can be learned from the unanticipated results of a so-called failure as from success, and NASA needs to reevaluate this culture in light of the practices of such institutions as the Naval Research Laboratory, which provides a more supportive environment in this respect. In addition, NASA

management needs to establish a reward system for those who make creative contributions to the development of low cost experiments and related equipment. Further, NASA must assure continued funding and other support for such "non glamorous" research as the acquisition of engineering data bases and the processing of data from continuing experiments.

3. The management problems associated with getting small experiments aboard the Shuttle today are complex and time consuming in terms of the cumbersome payload processing and integration management system. This situation could be significantly simplified if the Centers and experimenters could integrate and flight check their experiments in racks, pallets, or other mounts in their own facilities and then deliver them to KSC for easy integration into the Shuttle using a standard interface between the mount and the Shuttle. Funding needs to be increased so that there are sufficient experiment carriers available to the Centers.

4. Finally, we found during our fact finding that the Research Centers were not aware of Customer Services plans to improve other services for them. When we discussed this situation with Customer Services, they were quick to respond, promising to provide the Centers the same attention as other markets and to improve communications with them.

C. DOD UTILIZATION

We visited the Headquarters of the Air Force's Space Technology Center, Kirtland AFB, New Mexico, and met there with representatives of the Space Division of USAF, Air Force Weapons Laboratory, Naval Research Laboratory, Air Force Rocket Propulsion Laboratory, Air Force Geophysics Laboratory, Air Force Aero-Medical Division, and the Air Force Wright Aeronautical Laboratory. Some observations that were formed from these presentations and discussions are:

- o The DOD has the management structure and the necessary understanding to handle DOD experimental space payloads.
- o The DOD Laboratories are constrained by budget limitations.
- o These laboratories also feel that integration of their payloads into a Shuttle launch is overly complex and time consuming.
- o The DOD programs are integrated into the Shuttle operation by a single point of contact. This office is in the Air Force Space Division and seems to provide a useful function for the many DOD users.

- o These laboratories also expressed concern in the area of launch delays and schedule uncertainty and the impact on their programs from the standpoint of cost overruns and delay in obtaining needed program technical data.
- o The serial check out time at the launch center, KSC, was also raised as a serious problem and a strong feeling prevailed that payload buses or pallets would go a long way toward relieving this problem.
- o The DOD activity today represents a substantial effort.
- o With the recent Presidential announcement on space defense against ballistic missiles, this activity could increase significantly, increasing Shuttle workload.
- o The Task Force perceived an attitude among DOD users that the Shuttle program seemed to put more emphasis on the flying of the Shuttle than supporting the missions of the users, just as was perceived among other users.

D. COMMERCIAL R&D UTILIZATION

Our assessment of this potential research market is based on NASA's extensive effort to identify and cultivate prospective users and the collected experience and understanding of Task Force members. Our observations are:

The commercial market, other than the communication satellite segment, is principally a research and development market at this time. While the Task Force does not see a significant increase in the number of Shuttle flights now to support these experiments, there are a number of promising disciplines that could lead to new product development, space manufacturing, and an increase in Shuttle flights in the future. Therefore, it is worth continuing NASA's investment in anticipation of longer term, rather than immediate, potential return on the investment which the research promises.

The limited number of new product ideas, requiring space manufacturing and additional Shuttle flights, is not surprising at this time in view of the early stages of space research and the sales projection required to move into product development. It has been estimated that a company would have to expect additional annual sales of \$100 million to take the step of new product development. This situation suggests that NASA has done quite well in marketing Shuttle to date when the profitability of research has yet to be defined. This sales estimate may be a useful criteria for NASA to use in identifying market potential that should be supported by them.

The potential for a significant return on NASA's investment in new market development certainly exists. For example, approximately twenty companies are participating with NASA in research that has such commercial objectives as improved magnetic materials, abrasion resistant coatings, higher strength casting and structure, improved grain and yield of semi conductors, improved and new pharmaceuticals, and advanced fiber optics.

NASA's market development efforts will need to recognize that they will be dealing with a number of small users in an unorganized market. Therefore, NASA will have to understand the users' business and help them find the ways that Shuttle could be used by them as it currently does for major payload customers. NASA will need to provide streamlined organizational interfaces, such as a single point of contact for the user to work with during payload processing and simplified documentation, payload processing, and integration services to help them integrate their payload on Shuttle at minimum cost to them. Funding will remain a problem for this type of user, since it tends to be long term, high risk investment, and therefore NASA will need to provide appropriate pricing, incentives, and offsets. The recommendations in other parts of this report that address these issues are appropriate to this market. This potential is now receiving added attention in NASA.

E. RECOMMENDATIONS

In reviewing the general classes of potential users in the context of the question "Can Shuttle Utilization Be Increased?", the following conclusions and recommendations are submitted:

- o Because of the merits of the research, a concerted effort should be made to increase the funding level for space-related R&D at Government laboratories where there exists a small, well-defined workload in science, technology, and applications.
- o Action should be taken to streamline and simplify the process of getting this class of payload on Shuttle flights.
- o NASA, in concert with the DOD, should posture the Shuttle program to support actively the expanding defense space R&D program. We believe that the Shuttle should be deemed essential for national defense, with less importance attached to economics.
- o NASA should review its organizational structure and resource allocation in support of industrial R&D to assure that this small but important activity is properly nurtured.

NASA SPACE TRANSPORTATION POLICIES

A. INTRODUCTION

Available official policies (NASA Management Issuances 1214.1 and 1214.2), as well as many draft policies, were reviewed by the Task Force. In general, the Task Force agrees with most of the policies, with the exceptions listed below. The committee urges NASA to update and publish the official policies to avoid user confusion and to protect against future challenges. The Shuttle pricing decision made in June 1982 to use "out of pocket" costs is contradictory to the current official published policy and could be used by commercial ELV operators to challenge NASA's pricing policy in the future.

B. MULTILEVEL PRICING POLICIES

The Task Force reviewed NASA's present policies designed to encourage new space users (Exceptional Payloads, "Get-Away Specials", and Joint Endeavors) and considers them to be very good. The NASA concept currently under consideration (Hitchhiker) to provide low-cost transportation for standard interfacing intermediate payloads is also considered desirable and the Task Force encourages NASA to develop this program and offer this service to users.

A number of other additional inducements to potential space entrepreneurs were discussed, such as:

- o Special transportation discounts for the first several years of commercial operations
- o Longer term launch price commitments to cover the entrepreneur's investment pay-back period (note that NASA has more than doubled the launch price in a 3-year period)
- o Additional NASA facilities, such as free flyers, space station, etc., together with long-term commitments on their availability and pricing, would encourage more businessmen to make investments in space businesses.

The Task Force encourages NASA to consider the above and other such inducements to help create an environment conducive to private investment in space R&D. New space enterprises that may follow will reduce NASA's Shuttle operating overhead as well as provide economic benefits to our country. Because the Shuttle has no free world competition in performing manned R&D in space and in retrieving and returning processed materials from space, it should enjoy a monopoly in these types of space businesses for some time to come.

C. STANDBY AND POSTPONEMENT POLICIES

NASA's current policies in these areas appear quite harsh with respect to users. The sharp demarcations in postponement penalties at 12 months and 6 months, as well as the magnitudes of the penalties, seem unusually high to the users. The Task Force feels NASA should review the postponement policies with a view toward reducing the penalties, and treat any resulting funding shortfall in the same manner as the reflight guarantee (statistically as a small increase in launch price). Possible revisions include:

- o Graduated penalty from 5 percent (of their launch cost) at 12 months prior to launch to 30 percent at 1 month or less prior to launch
- o Increased "grace" period from 3 days to 5 days, permitting another 5 days at 1 percent penalty per day, half of which would be distributed to the other sharing payloads for the inconvenience

The standby payloads have had no takers at all yet, primarily due to the users' reluctance to tie up an expensive satellite for an extra 6 to 12 months. After considerable discussion, some of the user members of the Task Force conceded that it might make economic sense if the discount were greater. The Task Force feels NASA should study this question to determine whether, if the discount were raised, there would be takers, and whether this would be in the best interest of the overall system.

D. BACKUP LAUNCH VEHICLES

The NASA policy to phase out all expendable launch vehicles in the very near future came up for substantial debate. The consensus of the Task Force is that NASA is doing this prematurely. The Shuttle schedule reliability is not yet sufficiently mature to permit user confidence. The recent prelaunch problems on Challenger as well as the TDRS/IUS problem in flight illustrate the difficulties in adhering to rigorous schedules on this new and different system in this early phase of its operation. The Task Force recommends that the Delta launch vehicle be retained for some time into the future as a NASA launch vehicle complementary to the Shuttle. This could be accomplished by scheduling four Delta launches per year to keep the production line and launch operations at a minimally efficient level.

A common price should be charged for either a Shuttle flight or a Delta flight, even if a modest increase to the current price is required. Some payloads should be encouraged to be compatible with either vehicle and NASA should reserve the prerogative of assigning users to each vehicle (probably on a first-come,

first-served preference basis). Customers may be willing to accept a policy giving a price advantage to payloads with such dual compatibility. They may also be willing to accept a modest price premium for any user who insists on a Delta launch. This premium should be commensurate with the user's cost savings resulting from simpler integration and KSC processing procedures.

In addition, NASA should have some number of backup Delta vehicles available (around 6) to permit reassignment of Shuttle payloads when scheduling problems arise. It should be possible to accomplish such a switch within 4 months (witness the recent Exosat vehicle which was integrated on a Delta in 4 months). NASA should also continue to explore with the Air Force the reduction of the Delta range safety cost to the user to the same value as the Shuttle.

It should be noted that this concept would benefit all Shuttle users by providing a surge capability which would help hold all long-range schedules. The four Delta flights/year would reduce the Shuttle traffic approximately one flight/year, possibly causing the computed cost/flight to go up slightly, and would require a small increase in NASA's appropriation requirements for STS Operations. Such an increase could be offset by raising the current Shuttle price somewhat toward the "all reasonable costs" that are called for in the existing published pricing policies.

Another benefit of retaining the Delta vehicle is the ability to launch economically small satellites from Vandenberg AFB. NASA studies have shown that payload sharing at Vandenberg is not practical due to the low traffic and different orbits desired. Without a Delta capability, NASA would be obliged to fly an entire Shuttle for each Landsat or weather satellite.

E. STABLE FAVORABLE NATIONAL POLICY

Potential space entrepreneurs appear reluctant to make substantial space investments partly because they fear the Federal government's presently favorable policies in this area can easily change, and they will be left holding the bag. The recent OMB position stated in a letter from its Director to the NASA Administrator directed that no Shuttle capacity over the U.S. Government's requirements would be provided solely for the commercial sector, and that NASA should sell any excess space in a manner to minimize the cost to the government. A businessman considering investments that may take 8 to 10 years to break even would be very concerned that he could get squeezed out in future years as the U.S. Government traffic grows, or should one of the Orbiters be damaged.

This Task Force realizes that NASA alone cannot change this policy, but feels that NASA should give some attention to the formulation of a policy that would give guarantees of service for 15 or more years to space investors. This should then receive Presidential and Congressional review and hopefully be approved and publicly announced. Without this, the task force feels that commercial space business will be very slow to develop.

F. PRIVATIZATION

1. ELV Privatization

The Task Force debated this issue for some time with mixed results. All agreed that there is a low probability that profitable businesses will result from ELV commercialization as long as the Shuttle and Ariane are technically successful (as we expect them to be) and retain their present pricing policies.

There was a considerable feeling that the entrepreneurs currently seeking approval of ELV commercialization will start to lobby the Congress and the Administration against the present Shuttle pricing on the basis that it subsidizes a government monopoly and restrains free commercial trade. They may even seek to restrict the Shuttle from carrying commercial payloads. A part of the Task Force wanted to recommend against permitting ELV commercialization, but others felt that NASA could not realistically take such a position. In any event, if NASA implements the Task Force's recommendation on continuing the Delta, a substantial part of this question becomes moot, since the traffic for Atlas Centaurs and Titans is not expected to be large.

2. STS Privatization

The Task Force generally felt that the heavy NASA and DOD use of the STS would tend to make commercialization impractical. The matter of some government organization other than NASA operating the system was briefly discussed; the Task Force felt any such move in the near future would be premature, but agreed that this subject should be explored in depth several years hence.

G. OTHER POTENTIAL POLICIES

The Task Force felt that it would be highly desirable for NASA to adopt a "one-stop-shopping" policy to assist users in dealing with NASA, and to help them with financing, insurance, etc. The Task Force is aware of numerous NASA activities along these lines, but feels that more work should be done to centralize their control to minimize customer confusion and frustration.

H. RECOMMENDATIONS

The Task Force has the following recommendations on STS policies:

- o NASA should offer price and service inducements to stimulate private investment in space R&D and new uses for space transportation.
- o NASA should review the postponement policies with a view toward reducing the penalties, and treat any resulting funding shortfall in the same manner as the reflight guarantee.
- o NASA should review the discount policy for standby payloads to determine whether there would be takers if the discount were raised, and whether this would be in the best interests of the overall system.
- o The Delta ELV should be retained for some time into the future as a NASA launch vehicle complementary to the Shuttle (4 launches per year with 6 backups). The need for other ELVs should continue to be studied.
- o A common price should be charged for either a Shuttle flight or a Delta Flight, even if a modest increase to the current price is required.
- o NASA should give some attention to the formulation of a policy that would give guarantees to space investors of stable service for 15 or more years.
- o NASA should go slow on STS privatization.
- o A "one-stop-shopping" policy to assist users in dealing with NASA should be adopted--including financing, insurance, etc.

SHUTTLE MARKETING

A. INTRODUCTION

The Shuttle program, with the successes of Columbia and Challenger, is pushing the U.S. manned space program and NASA into a new era--the operational era. The initial research and exploration of Mercury, Gemini, and Apollo; the science, applications, and human research of Skylab; and the politics of Apollo-Soyuz are history. In addition to the traditional aspects of safety and mission success, NASA must become increasingly concerned with customers and their payloads. The Shuttle provides a space transportation service. The customer and his payload now take on an importance greater than at any time in NASA's history. To deal with the challenges of this new operational era and the customer's increasing importance, NASA has entered the realm of marketing and customer service, and the Task Force reviewed NASA's activities in this area.

B. CENTRAL MARKETING ORGANIZATION

1. Organizational Location and Management

Because of the diverse nature of Shuttle customers (DOD, NASA, U.S. commercial, foreign governments, and foreign commercial) and the complexity of the Shuttle system, it is necessary that the marketing organization be strong and centrally controlled. It should have the marketing responsibility and authority required to identify customers, determine their needs, and influence organizational elements within NASA to provide for those needs. A fragmented organization would have little chance of success.

There are several options for locating this marketing responsibility, including within NASA, within a non-NASA U.S. Government organization, in private industry (under contract to NASA), or in a quasi-governmental organization. While each option has some particular advantages and disadvantages, the recommended location is within NASA--as long as NASA is responsible for operation of the Shuttle. This recommendation is based on several factors, including: (1) the high level of technology involved in the service and the excellent NASA technical reputation, especially overseas, where many sales will be direct government-to-government; (2) the difficulty of splitting the marketing function from the operating function; and (3) the international treaties, offset agreements, and international diplomacy involved in sales and launches.

It is important that this central marketing organization be correctly placed within NASA and that it be properly presented, both internally and externally. Historically, NASA responsibilities have been in research, development, and

exploration. This has developed a culture which places the engineer, scientist, and astronaut in an esteemed position within the NASA hierarchy. As the Shuttle program moves into the service-oriented operational era, this culture must change. The customer and his payload now become a vital element of the operation and the customer's representative (the marketing organization) must take a proper place within NASA's hierarchy. For these reasons, it is recommended that a senior Shuttle marketing executive position be established. A very strong individual, who will command the respect of both the internal organization and the customers should be appointed to this position. As long as Shuttle operations are the responsibility of the Office of Space Flight, the individual should report directly to the Associate Administrator for Space Flight, with an appropriate title such as Deputy Associate Administrator, Shuttle Customer Services. This responsibility should not entail the marketing of ELVs--except as required for backup to the Shuttle. It is recommended that NASA, in selecting the top marketing executive, explore all possibilities both within and outside NASA (including astronauts). With this senior marketing executive properly placed within NASA and supported by the Associate Administrator, it should be possible to effectively pull together all the organizations presently involved in customer services and Shuttle marketing. NASA has already recognized the need for customer liaison and currently has several organizations involved in customer contacts. All these efforts should report directly to the Shuttle senior marketing executive in a "hard line" relationship. In addition to customer liaison, the responsibilities of this executive should include planning, market analysis, competitive analysis, strategy, pricing, and the development of marketing functional excellence within NASA. All present and potential customers should be covered within this area. The organization should be staffed and structured so as to understand in depth the needs of this diverse group of customers. "Cradle-to-grave" customer service should be emphasized with effective pre- and post-contract follow-up.

Operations management must support sales and marketing. The bridging of the gap between R&D and a customer orientation that provides the reliable operations required by the customers did not come easily for the airlines. The senior marketing executive must have the authority to assure the priority of marketing in operational decisions.

Of course, should the responsibility for operating the Shuttle be placed elsewhere, either within NASA or outside, the marketing executive would move with the operations organization and report directly to the head of that organization.

2. Private Sector Support

The level of resources which NASA has applied to the marketing function is low in comparison to the size of the business when contrasted to private sector marketing practice. Realizing the headcount and other restrictions under which NASA and its employees must operate, we recommend that NASA select a single company with aerospace and/or marketing know-how to provide contract support services to NASA and its customers. This support contractor could aid NASA in providing Shuttle operations information, integration assistance, and mission analysis to the customer. In addition, it could be involved in the market planning, analysis, and sales efforts. It is recommended that this support service contractor be assigned directly to the senior marketing executive as an augmentation of the NASA staff. One contractor, rather than numerous contractors, is recommended to maintain continuity of personnel and simplify management. By utilizing contract support services, NASA can benefit from the extensive private sector expertise in sales, marketing, and Shuttle integration.

C. MARKET PLANNING AND ANALYSIS

The preparation of a marketing plan is required for an organization to be effective. It is imperative that goals and objectives be established and strategies to achieve these be implemented. NASA top management should, of course, establish the goals and objectives for the total Shuttle program. The senior marketing executive should be intimately involved in establishing those goals and objectives associated with Shuttle operations. Functional goals, objectives, and strategy can then be formulated by the marketing staff. Thorough market research and analysis must be completed before strategy or action plans can be established. The market analysis for the Shuttle should include a thorough analysis of the environment, customers, and competitors.

D. MARKET ENVIRONMENT

Today's market environment is one of transition. Customers are transitioning from expendable launch vehicles to the Shuttle. The DOD is fully committed and is designing its payloads for Shuttle. NASA is developing payloads for the Shuttle and at the same time must provide upper stages where required. Commercial customers are faced with the phaseout of some launch vehicles and the introduction of the Ariane. Potential customers have numerous concerns, including: (1) the dependability of both the Shuttle and the Ariane; (2) the fact of being just one of multiple payloads on the Shuttle; (3) the additional complexity of processing and paperwork; (4) the pricing structure; (5) excessive time requirements at KSC. As we noted earlier, the option of flying payloads on either Shuttle or ELVs is viable in

the short term. For the longer term, customers still buying spacecraft designed for both expendable launch vehicles and Shuttle would not be taking full advantage of a payload design optimized for the Shuttle. Many of the customer concerns are expected to fade away as the Shuttle demonstrates reliable, on-schedule performance. With a marketing function acting as the customer's advocate within NASA, many customer irritants should be alleviated.

E. CUSTOMER ANALYSIS

Analysis is needed to determine who the customers will be in the long term (3-10 years). It is necessary to be working on potential service requirements well into the future. Potential customers should be encouraged to tailor their product to the Shuttle and its multiple specialized services such as in-flight check-out, sortie missions, and retrieval and repair. DOD requirements may grow dramatically, and as new military doctrine is developed, participation by NASA can provide the relevant insights into Shuttle capabilities. At the same time, NASA can gain an understanding of DOD's underlying requirements. Working closely with DARPA and the aerospace industry can keep NASA abreast of those DOD systems that might become Shuttle payloads. Customer identification and analysis should be an important ongoing activity.

F. MARKETING TOOLS

To implement a winning marketing strategy, it is necessary to have effective marketing tools available. These can include pricing flexibility, flying a customer representative with the payload (astronaut), financing, insurance, offsets or buy backs, and other contractual terms and conditions.

1. Pricing

Pricing is probably the most valuable marketing tool available. Total cost (including the cost of delays) is normally the single most important customer decision factor. Consequently, it should be one of the most important points considered in establishing a marketing strategy. Some alternative pricing strategies include maximizing revenues, maximizing total profit, minimizing NASA subsidy, meeting competition, maximizing use, and optimizing user value.

It is also important to consider the alternatives of fixed versus negotiated prices. If prices are to be negotiated, it is important that NASA should have experienced, professional, commercial negotiators. Varying price structures, depending on customer needs, should be considered. The commercial communication satellite and the embryonic manufacturing experiments require different pricing treatment. As noted in a

previous section, NASA should thoroughly review its pricing policy to determine if it is consistent with its goals, objectives, and supporting strategy.

2. Financing

The purchaser of launch services, in almost all cases, lines up financing for both the progress payments for payload and the launch services at the same time.

Generally, when the U.S. government or well capitalized users add a satellite to a system, the financing will appear to be loosely coupled to the purchase. The buyers will raise funds on a periodic basis to finance total capital expenditures, of which the procurement of the satellite (and launch services) would be only a small portion. Obviously, offering financing arrangements without extraordinary subsidies would have little appeal to these buyers.

For more thinly capitalized buyers, financing tends to be on a "project" basis, i.e., financing will be available against availability of adequate advance revenue commitments to repay loans. Examples of these techniques are pre-sales of transponders or obtaining long term user commitments. Usually, the financing structure is closely related to the economic lives of the satellites.

Foreign government buyers take a half-way position; the financing structure tends to be closely related to the characteristics of the system, while the pre-committed revenues are not as crucial to the financing as the general credit capacity of the country.

Today's communication satellites and launch services generally require three years of progress payments prior to launch. In the most stringent cases, loan facilities would provide advances for the progress payments and would be amortized over the design (or insurable) life of the satellite. Since today's communications satellites have design lives of 10 years, thirteen-year loan facilities would be within the ability of one financial structure, i.e., one bank, institutional, or government loan, to support a project. Consequently, a buyer's financing strategy would most likely be to arrange for complete financing at the outset and subsequently employ tax subsidy techniques on a subsequent, opportunistic basis to reduce financing costs.

An example of the use of tax subsidy would be a sale/leaseback of an exported satellite to enable a transfer to tax benefits to a U.S. taxpayer. The "sale" of tax benefits would take place after launch and successful delivery to, and operation in, the orbit slot is confirmed. In this transaction, a satellite with launch charges included would be sold cost

insurance freight in its orbit position to a U.S. taxpayer, who would lease the system to the ultimate user at a rate reduced by the tax benefits enjoyed by the taxpayer. For a 1986 delivery, a typical communication satellite financing rate could be reduced by approximately 550 basis points from a 12 percent debt rate with approximately 68 basis points financing cost reduction for every 100 basis point reduction in the debt rate. Since the value of the satellite would include launch service charges, this mechanism would in effect apply tax subsidies to the launcher that would not otherwise be available prior to launch.

NASA up to this point has become involved in the financing primarily when there is financing competition from Ariane. There are three basic situations where this occurs, exporting to non-EEC areas, exporting to the EEC, and selling to domestic U.S. users.

a. Exporting to non-EEC Areas

In foreign non-EEC areas, Arianespace and NASA offer similar financing terms as long as the ExIm Bank cooperates. Arianespace will finance 80 percent of the cost, of which 80 percent of the debt will be at a subsidized rate. Recently, the amount of subsidy was 64 percent (at 9.5 percent) from Compagnie Francaise d' Assurance Pour Le Commerce Extérieur, and 16 percent (at 10.5 percent) from Hermes, which provided a blended subsidized rate of 9.75 percent. The remaining 20 percent of the 80 percent financing of funding would have been at market. Arianespace would have provided 36 months of progress payments with a five year amortization commencing 6 months after launch. In the Mexican transaction, ExIm guaranteed 85 percent of launch services up to 13 years with 85 percent of the funding coming from PEFCO, the Private Export Funding Corporation.

PEFCO is owned by 52 banks and manufacturers. Its function is to provide funding against ExIm guaranteed paper. Its rates are essentially the prevailing market rate for U.S. government guaranteed obligations plus a commitment fee and arrangement fee.

In the case of financing facilities for non-EEC countries, both the European Export Agencies and ExIm have bid to provide subsidized financing that was consistent with Organization for Economic Cooperation and Development guidelines.

In addition to the Mexican transaction, NASA was successful in offering ExIm packages in Australia and Columbia that were competitive with European offers. In virtually all cases the difference between Shuttle and Arianespace rates and terms were not significant. Except for

the loss of a Brazilian launch due to a development loan and offsets, NASA has not lost any launch business due to more competitive financing. Based on recent discussions with senior officers of the ExIm Bank, there is every indication that the ExIm will be responsive to export financing for non-EEC countries, particularly when there is competitive European export financing involved.

b. Exporting to the EEC

In the EEC area, neither NASA nor Arianespace can employ subsidized financing. No EEC export agency will provide subsidized financing to another EEC member. When there is no subsidized, competitive financing available, ExIm Bank will not participate.

Since Arianespace has an advantage in securing the launch service business in the EEC, it may not be a big market for NASA. Since export financing is not available, the burden of financing would fall upon the purchaser of the payload and launch services. However, because of the close relationship between the governments and banks in Europe, it is possible that Arianespace could succeed in offering attractive commercial financing to potential customers. In that case, NASA, in conjunction with a U.S. payload exporter, could be placed in the position of having to assist in the development of financing packages from commercial sources in the U.S. or Europe.

c. Selling to Domestic U.S. Users

In the United States, Arianespace has provided 80 percent financing at a subsidized rate, currently 12.4 percent. NASA has had no equivalent ExIm support. There have been many statements about the subsidy advantage that Arianespace has over NASA in the U.S., especially since the ExIm will not match the subsidized financing. However, the Arianespace financing up to this point did not present a big enough discount off the advertised Arianespace price to affect significantly and adversely NASA's marketing of the Shuttle.

However, this could become a serious competitive disadvantage in the future if prices equalized. The ExIm is aware of this problem but up to this point, except for some discussion, there has been no overt pressure on the ExIm to assist in meeting such subsidized financing. It may be that some sort of ExIm financing or other government intervention to block such subsidized financing to U.S. customers may be necessary.

3. Insurance

Launch insurance provides protection against loss due to untoward events from ignition through a time in orbit when it has been determined that no damage to the satellite has occurred due to the launch. Except for the most strongly capitalized or sovereign buyers, the insurance is essential to commercial financing of satellite systems. Launching is the riskiest and most stressful time for a satellite. Consequently, launch risk premiums may be 10 or more times the size of premiums for any other types of insurance coverage for satellites.

Today, most space underwriting risk is assumed by Lloyds of London. In today's market, rates have not been high enough to prevent insurance underwriters from consistently suffering losses. This loss record has resulted in a limit on underwriting capacity per launch.

This limit creates a unique problem for the Shuttle. At present, underwriting capacity is approximately \$150 million per launch. Assuming \$50 million satellites are delivered to the pad, a Delta launch and a Centaur launch will allow full insurance with launch values of \$90 million and \$120 million respectively. In the Shuttle case, there is a problem because certain commercial flights are expected to have 3 payloads having a total value of \$150 million before launch. When \$90 million of launch services are added to this, the \$240 million cost exceeds the insurance capacity. A way to alleviate this problem is to mix some commercial payloads with non-insured government payloads.

Hopefully, additional successful launches, higher insurance fees, or a combination thereof might lead to increased insurance capacity. Until then, NASA should consider writing, for a fee, some of its own insurance. Specifically, NASA could employ its space expertise to be, at its discretion, an "insurer of last resort". In a loose analog of the Federal Reserve relationship to the U.S. banking system, NASA would, subject to its evaluation, and at a higher price than the highest force premium, offer insurance to cover underwriting any shortfalls. The price would be set high enough to encourage commercial underwriters to enter the market, and would be replaced as soon as such insurance could be obtained.

4. Other Marketing Tools

A major weakness in NASA's present marketing tool box is the general inability to offer offsets, i.e., arranging purchase of products or making an investment, both unrelated but still supportive transactions, in a purchasing country. This practice is "normal" for aerospace exports, and other countries have taken advantage of this. An example of how offsets were used to

compete with NASA was Arianespace's capture of the Brazilian satellite system by obtaining a French government commitment to offer a combination of a purchase commitment and 30-year subsidized rate loan of 120 percent of purchase price. For the Aussat, the Australian government required the investment in Australia to produce, or the commitment to purchase, high technology products up to 30 percent of the value of the launch. Except for an ad hoc opportunity in Australia, NASA has not been able to provide this service because it does not have the requisite charter. In certain cases, NASA's contractors can also, on an ad hoc basis, step in, as was the case in Australia. However, the opportunities are limited to those contractors who have something to gain by the particular sale. Banking institutions and trading companies have developed some capability to support offset requirements through various trade and barter activities. In this role they tend to act as export brokers. However, in today's markets, these activities are generally limited to commodities which have worldwide demand. Therefore, NASA should work with the Office of the Special Trade Representative, the Department of Commerce, and the State Department to develop an offset program including a wider variety of goods and services.

G. RECOMMENDATIONS

An intensive marketing effort on behalf of Shuttle utilization is warranted. In this context, marketing means to develop and implement a broad scale and long-range plan to involve increasing numbers of users in the exploration of the STS capabilities. It thus involves market analysis, planning, advertising, customer service, financing and insurance, and operations. It must be a high level, strongly led effort, with the active participation of NASA top management. Our recommendations are:

- o NASA should strengthen its central marketing organization to deal with the Shuttle customer and Shuttle operations. This should include undertaking a number of marketing-related actions, and establishing policies to provide the necessary marketing tools.
- o A position of Deputy Associate Administrator for Space Flight, Shuttle Customer Services, or its equivalent, should be established.
- o NASA should select a single private company to assist in the marketing of the Shuttle and to provide contract support to NASA and its customers in the entire interface area.
- o NASA should establish a detailed marketing plan with top management review and approval.

- o Arianespace financing should continue to be closely tracked to preclude any unfair advantage, which, in turn, might require ExIm bank response.
- o NASA should consider writing, for a fee, some of its own insurance.
- o NASA should continue to work with the Office of the Special Trade Representative, the Department of Commerce, and the State Department to develop an offset program including a wide variety of goods and services.
- o NASA should install a senior customer finance man in the customer support group.